

TECHNICAL SPECIFICATIONS

Horizontal Centrifugal Pump

1.1 General

The pumping unit shall consist of a best efficient horizontally split-case, single-stage and double suction type directly connected through a flexible coupling to a horizontal induction motor.

The construction of the pumps shall be such that no damage will occur to the pump, attached motor or controls if reverse rotation takes place. Mechanical brakes or ratchets shall not be permitted.

Each pump casing shall be split along the axis of the shaft to permit the removal of the Impeller and shaft assembly without dismantling the pipe work. Half casings shall be dowelled to ensure alignment. Jacking screws shall be provided to facilitate dismantling. **And also the bearing housing on both driving and non-driving end is casting along with the lower casing of the pump.**

Pump internal painting shall be fusion bonded Glass Flake (Drinking Water Quality) coating, proposed pump vendor shall have facility for above requirement at his factory. The evidence of such facility shall be submitted at the time of bid.

All the pumps of same duty shall be of similar characteristic.

The pumps shall be designed for continuous duty at rated parameters and should be capable of pumping the flow ranges specified in Particular Specifications. The rated capacity and head of each pump shall be as specified on relevant datasheets and / or particular specifications. The pumps and associated equipment shall include all necessary provisions to prevent contamination of the drinking water being pumped.

The pumps shall be designed to operate satisfactorily without detrimental surges, vibration, noise, or dynamic imbalance over the required head range.

The pumps shall be capable of reverse rotation up to 125% rated full speed of the drive motor, due to back flow of water, without damage or loosening of threaded components.

Flanges shall be machined on faces and edges and conform to ISO 7005, IS 6392, BS EN 1092 or equivalent International Standards. Back faces of flanges shall where necessary be machined to ensure they are parallel to the front faces and that flange bolts can be fitted flush to the flanges.

There shall be multiple pipe tap connections, two at the bottom of the lower casing as a drain and two more for pressure gauges. One at the top of the upper casing as an air vent. Additional tapped connections shall be provided at any other high points in the upper casing.

All piping work shall be done for drain taps with SS316 materials along with required fasteners, bolts and nuts etc. Also 100mm dia Pressure Gauges of 0 -

25 bar range of anti-pulsation dampener (Baumer Make) shall be provided in the lower casing of the pump with necessary piping and etc.

The top of the upper casing shall be fitted with a gate valve. Automatic float type air valve with isolating cock shall be fitted at the highest part of the casing to assist priming. The drain shall also be fitted with a gate valve.

All provision shall be provided in order to install temperature sensor for bearings, vibration sensors for pump casing and bearing housings.

The pump casing shall be provided with removable and renewable wearing rings where there are close-running clearances between the impeller and the casing. The casing shall be so constructed that the drains will dewater the entire casing.

All specified accessories and any other standard accessories required for correct and safe operation of the pump shall be furnished with the pumps.

The weight of the pump including all components should be equal or greater than 3500kg (dry).

Note: One set of Complete Rotating element Components shall be supplied, excluding Impeller and coupling, and the Cost shall be included in the price schedule and no extra cost shall be paid. Spare parts supplied with the pump shall be identical to respective pump components and shall be from original pump manufacturer.

Mild steel fabricated coupling guard shall be provided for safeguarding against the open rotating parts of the pump and motor. Guard shall be designed for easy installation and removal, complete with necessary support, accessories and fasteners. All bolts, studs, nuts and washers shall be corrosion resistant.

Flexible pin bush type coupling or any improved design shall be provided by the bidder, duly bored and keyed to the pump and motor shafts. The coupling and the pump shafts shall be designed so that the breaking load of the coupling system is slightly below that of the shaft. The coupling shall be designed to take care of any minor misalignment of pump and motor assembly.

1.2 NPSH

The Contractor shall guarantee that adequate required Net Positive Suction Head (NPSH) is available to ensure that pumps can operate without cavitation under the worst operating conditions. The NPSH requirements of pumps, based on the 3% head drop criterion, shall be at least 1m less than the NPSH available at complete pump working range including pump duty conditions at site, at the lowest water level in the sump and maximum ambient temperature and maximum water temperature 45 degree- C.

1.3 Parallel Operation

All pumps in the pumping station must be capable of running satisfactorily in parallel operation of 3 pumps in the system without throttling, and without cavitation or overload under all operating conditions within the system resistances indicated.

1.4 Balancing

All rotating parts individually and in assembly shall be statically and dynamically balanced to prevent vibration through a range of normal and reverse speeds.

Rotating assemblies shall be statically and dynamically balanced in accordance with ISO 1940-1 and ISO 21940-11 and designed so that the first critical speed of the pump and its drive is at least 30% higher than the maximum operating speed.

Unbalanced, hydraulic, radial thrust acting upon rotating elements shall be kept being minimum.

The unit shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to water returning through the pump at times when the power supply to the motor is interrupted and the Non return valve fails to close.

1.5 Vibrations and Noise

Pumps shall run smooth without undue noise and vibration. The velocity of vibration shall be within the specified limits 4.5 mm/sec. Combined noise level of pump motor system when 3 pumps are running simultaneously shall be limited to 85 dBA at a distance of 1.86 m.

Pumping Units shall be provided with Vibration switches for Pump Vibration Monitoring.

All the pumping units shall be supplied with machined pads to allow the fitting of portable vibration monitoring transducers. One portable vibration monitoring equipment capable of measuring and recording velocity and vibration shall be supplied for the pumping station.

1.6 Impellers

The impeller shall be the enclosed type and shall be fastened to the shaft in such a manner as to make it readily removable. The water passages of the impeller shall be hand finished to remove rough spots and excessive irregularities. Removable and renewable wearing rings shall be provided on the impeller where there are close running clearances between the impeller and the casing. Hardness of the casing ring shall be 50 BHN lower than the impeller ring. Unless otherwise specified, removable wearing rings shall be provided on the pump casing. Materials and hardness of the casing and impeller wearing rings shall be selected to ensure that they are not susceptible to galling and premature wear.

The impeller shall be at least one size lower diameter than the maximum impeller size that can be fitted in to the pump casing. In other words, by replacing the impeller to the next higher size an increase in discharge of at least 5% more than the specified here should be possible.

1.7 Main Shaft

The Main shaft (**shaft diameter should be $\geq 120\text{mm}$**) is supported by the bearings. And the impeller is set on the shaft at the middle of the bearings.

It transmits the output power of the motor to the impeller. Thorough examination has been made on torsional and bending stress and critical speed, so as to ensure sufficient strength and durability.

1.8 Bearings

The pump shaft shall be supported by three bearing;**a deep groove type ball bearing (6324) is used in driving side. A set of Angular Contact ball bearing (7324) is used in non-driving end.**Both bearings are lubricated with oil. One bearing on the pump shall be of the thrust type, designed to withstand the unbalanced axial hydraulic thrust. Suitable fittings shall be furnished for the type of lubrication provided. Bearings shall have a minimum life L-10 type of 40,000 hours of operation. Pockets or pads shall be provided in the pump bearing housings for insertion of portable instruments probes for measuring the bearing temperature.

At initial stage of pump operation, the data of bearing vibration as oscillating wave, and its production number shall be submitted to the Engineer to identify the life cycle or determination of replacement.

1.8 Shaft sleeves and Mechanical seals

Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing boxes. Shaft sleeves shall be securely locked or keyed to the shaft to prevent loosening. Shaft and shaft sleeve assembly shall ensure concentric rotation. Minimum surface hardness of shaft sleeves shall be 400 BHN. Water deflectors shall be provided on the shaft to prevent water from passing along the shaft and entering the pump bearings.

Mechanical seals SiC v/s SiC to be provided with self-lubrication arrangements as per API standard 682. Seals shall be provided to prevent loss of lubricant and entrance of moisture and dirt into the bearings.

1.9 Base Frame for motor and pump

The pump and motor shall be mounted on a common base frame plate (**weight should be greater than 500 Kg**). The pumping unit shall be provided with a fabricated structural steel base frame. Holes for holding-down bolts shall be included, and all packing for levelling, and all holding-down bolts shall be provided. Steel dowels shall be fitted after final alignment of pump and motor to facilitate dismantling and reassembly.

The base frame shall be of sufficient size and rigidity to maintain the pump and motor in proper alignment and position. All contact surfaces between the pump and base-plate and between the motor and base frame shall be machined and shall be provided for transmitting the entire load due to discharge Shut off pressure to the concrete structure. After the unit has been installed and properly aligned, the base frame will be drilled and reamed for the dowels. The necessary dowels anchor bolts shall be furnished with the pump set. The pocket depth for anchor bolts shall be limited to 600mm. The pump base, or the supporting bracket, shall be drilled in the shop for doweling to the base plate at the Site. The Pump shall be painted with Electro static epoxy (Food grade quality) outside coating for a minimum DFT of 250 Microns.

The Successful bidder shall visit the pumping station and take all necessary measurements of existing motor base bolt centres and pipeline centrelines for preparation of detailed drawings and fabrication.

1.10 Pump performance

Pump performance guarantees shall relate to the flow rate, the total head and the efficiency of the pump as specified in this document shall be verified and confirmed when tested at the manufacturer's works. The same shall be verified and confirmed during site tests on completion.

Pumps shall operate at design duty within the acceptance tolerances for flow and total head laid down in ISO 9906.

Unless otherwise specified, at the time of tender the Contractor shall supply the performance curves for the pumps he is providing. The curves shall show total head, pump efficiency, power absorbed by the pump, and NPSHr plotted against flow rate for the full operating range required. The curves shall be extended to show shut valve conditions, and to show performance at flow rates at least 25% in excess of the maximum flow rate expected in normal operation at site conditions.

Where appropriate, curves shall also be included to show the variations in station losses and internal plant losses plotted against flow rate, to enable the complete pump performance curves to be shown.

If the Employer's estimated system curves for head against flow have been provided, the Contractor's pump curves shall be superimposed on the system curves to show conveniently the expected performance in site conditions.

The contractor shall make necessary arrangements and ensure that each pump shall be tested and verified at manufacture's factory with the applicable provisions of the American Standards of the Hydraulic Institute, or JIS B8301: 2018, "Rot dynamic Pumps-Hydraulic performance acceptance tests" Grade 2, or ISO 9906 "Rot dynamic Pumps - Hydraulic acceptance tests" Grade 2. Factory performance test reports shall be provided for all pumps.

All the testing and inspection shall be carried out at Original Equipment Manufactures(OEM) factory and charges to be borne by the contractor. The inspection/testing shall be carried out as per approved Quality assurance plan after approval from the Employer.

The pump efficiency shall not drop below 1.5% from original performance pump efficiency after more than 5 years continuous operation.

The Pump Manufacturer should supply pumps to match the existing motors with new foundation. A technical support letter providing confirmation of same should be provided by Pump Manufacturer to bidder.

1.11 Sump Model Study

The Contractor shall carry out comprehensive sump model study on the complete pumping station under all operating conditions. The contractor shall provide Physical model or Computer model using CFD Analysis software which is acceptable to Employer. The study/analysis shall be conducted on established procedures in house or reputed research institute/ agency/laboratory which

shall be subjected to the approval from the employer. The CFD analysis shall be undertaken using a proven computer programme/model and accepted in water industry. To improve the performance of pumps, the Contractor shall perform sump model studies for the proposed system considering various pumping combinations. The sump model study shall have to be taken up and completed before the finalization of sump design. The tests shall be conducted considering the design parameters. A simulation study has to be carried out for various operating conditions and outcome of the study shall reflect in design and drawings. The sump model study report shall be wetted and approved technically by institute like IISC, Bangalore, and cost of same shall be deemed in the price bid of bidder. The proposed pump manufacturer shall submit CFD/Sump model Analysis to prevent vortex from Suction Pit.

Squirrel Cage Induction Motor

Stage 1 Pumping Station :Technical Specification

Motor Rating	1350 kW
Voltage Class	6.6 kV $\pm$ 10%
Make	ABB
Frequency	50 Hz$\pm$ 5%
Frame	AMA 450L4A BAI
Speed	1489 RPM
Current	142 Amp
Power Factor	0.87
Rated Torque	8655 Nm
Connection	Star

Stage 2 Pumping Station :Technical Specification

Motor Rating	1250 kW
Voltage Class	6.6 kV
Make	NGEF
Frequency	50 Hz
Frame	A 630 M4
Speed	1488 RPM
Current	128 Amp
Power Factor	0.9

Connection	Star
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Note: The Stage 2 Pumping Station Motor details are provided as per Name Plate of the Motor.

SECTION - I

EARTH WORK

1.0 INDIAN STANDARD

Work shall be carried out to Indian Standards and Code of Practices, in absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/conflict noticed shall be directed to the officer in charge for his direction /approval. However as a general rule more stringent specification shall take precedence.

- | | | |
|-----|----------------|---|
| (1) | IS 1200 | Method of measurement of Building and Civil Engineering works. |
| (2) | IS 1498 | Classification and Identification of soils for general engineering purpose |
| (3) | IS 2720 | Method of test of soil |
| (4) | IS 3764 | Safety code for excavation work |
| (5) | IS 4081 | Safety code for blasting and related drilling operation |
| (6) | IS 6313 Part 1 | Code of practice for anti termite measures in buildings: |
| | | Constructional measures. |
| | | Part 2 Code of practice for anti termite measures in buildings: |
| | | Pre constructional chemical treatment measures |
| (7) | SP 27 | Hand book of method of measurement of building works
Explosive Rule 1940 |

2.0 SITE CLEARANCE

2.1 Prior to the start of any activity of earthwork, the area under construction shall be cleared of shrubs, vegetation, grass, brushwood, trees and saplings of girth upto 30 cm measured at a height of 1 metre above ground level. All rubbish must be removed and stacked at a distance of 50m outside the periphery of the area under clearances or location as decided by the officer Incharge

2.2 The rate of such clearance is to be included in the rate of other earthwork items and no separate rate shall be paid.

3.0 SETTING OUT

3.1 The contractor shall prepare detailed setting out drawings based on the layout of Architectural drawings and those shall be submitted to the Incharge prior to commencement of work. Bench Marks and Reference Lines shall be established, by the contractor with approval of the Incharge

3.2 The contractor shall do the setting out with the use of theodolite and like instruments at site, based on details given to him. He shall erect timber profiles, masonry pillars, burjis, etc. for his use. All markings on these shall be painted with red colour and they shall be maintained for the entire duration of the project. Setting out shall be approved by the Incharge before the commencement of any work.

3.3 The rate for the earthwork items shall include expenses for all such work including labour, material and equipment/ instruments, etc. No additional payment shall be eligible on this account.

4.0 EXCAVATION IN SOILS

4.1 Excavation over area

Excavation exceeding 1 m in width as well as 10 sq m in plan and 30 cm in depth shall be considered as

4.2 excavation over area.

Surface dressing

Trimming of natural ground, excavated surfaces, and filled up areas to remove vegetation and/or small inequalities not exceeding 15 cm in depth shall be described as surface dressing.

4.3

Rough excavation

Excavation not requiring dressing of sides and bottom and reduction to exact levels, such as winning earth from borrow pits, hill side cuttings, etc. shall be described as rough excavation.

4.4

Surface excavation

Excavation exceeding 1 m in width as well as 10 sq m on plan but not exceeding 30 cm in depth shall be considered as surface excavation.

4.5

Trenches for pipes/cables

It shall be detailed with nominal dia of pipe/cable. Required bottom width, allowance for concrete foundation for laying pipes, working area, grip required for socketed pipe, return fill, ramming and removal of surplus soil shall be part of this item unless otherwise specified. It shall generally be measured in cubic metres unless specified specifically as running meter in the BOQ.

4.6

4.7

4.7.1

Post holes

Independent post holes (or similar holes) each not exceeding 0.5cum shall generally be enumerated. Rate shall include return fill, ramming and removal of

4.7.2

surplus soil. However this shall be in cubic meters as part of excavation items.

General

- 4.7.3 The excavated earth, shall be thrown or disposed off beyond 50 m periphery of the building. Earth suitable for backfilling shall be stacked separately.

Subsequent disposal of the surplus and unsuitable material shall be as per the respective items. Foundations, trenches shall be dug out to the exact dimensions as shown in the drawings or as directed by the Incharge

- 4.7.4 In firm soil, the sides of the trench shall be kept vertical upto a depth of 2 m. If the trench is to be deeper, it shall be in the form of steps of 50 cm, at every 2m depth. This shall be suitably increased or decreased as per site conditions and type of soil met with. This shall be to the approval of the Incharge. Sloping of sides also may be adopted.

The bed of trenches shall be firmly consolidated and leveled by watering and ramming of the soft soil. Defective spots shall be dug out and filled with concrete of the same mix as of PCC or as directed by the Incharge. Cost of digging and filling with concrete shall be paid extra if excavation and PCC is measured separately.

If excavation is done to a depth greater than that required, excess depth shall be back filled with the same mix as of PCC or as directed. Cost of such concrete shall be to the contractor's account.

Excavated trenches shall have to be approved by the INCHARGE prior to laying of PCC or any other Permanent Work.

- 4.7.5 Excavation for drains shall be carried out with extra care to cut the sides and bottom exactly to the required shape, slope and gradient.

- 4.7.6 Filling for excess deeper excavation shall be done at the contractor's cost in consultation with the Incharge
- 4.7.7 Excavated materials shall not be placed within 1 m of the edge of the trench or half the depth of the trench, whichever is more.

- 4.8 Excavations for column footings shall be carried to depths indicated in the drawings. Safe bearing capacity at such depth shall be verified to comply design requirements. If ordered by the Incharge, appropriate tests shall be carried out by the contractor.
- 4.8.1

Protection

- 4.8.2 Fencing and/or other suitable measures for protection against risk of accidents due to open excavation shall be provided by the contractor at his cost.

Where excavation is to be carried out below the foundation level of an adjacent structure, and to avoid underpinning, precautions such as shoring and strutting, etc. must be taken. No excavation should start till such measures are taken to the satisfaction of the Incharge. Payments for such work shall not be made separately unless specified otherwise.

5.2 **EXCAVATION IN SOFT ROCK**

- 5.0 This shall be carried out by crowbars, pickaxes or pneumatic drills or any other suitable means. Blasting may be permitted if the contractor so desires but no extra money shall be paid for blasting. Measurements shall be in cubic meter.
- 6.0
- 6.1 Other general details same as clause 4.7. and its sub clauses.
- 6.1.1
- 6.1.2

EXCAVATION IN HARD ROCK

General

- On meeting hard rock that requires blasting, the contractor shall inform the Incharge On approval in writing, blasting operation shall start if the contractor feels it necessary and so desires.
- 6.1.3
- 6.1.4
- 6.2 The contractor shall obtain the necessary license from the District Authorities for undertaking blasting work and explosive storing as per Explosives Rules 1940, and as updated. Explosives shall only be procured from an authorised dealer. He shall be responsible for the safe custody and proper accounting of explosives. The Incharge shall have access to the store.
- 6.2.1
- 6.2.2

The contractor shall be responsible for any accident to those working on the site, to the public or to property due to blasting operations.

Measurements shall be in cubic meter by stacking rock and applying predetermined deduction for voids.

Precautions

Safety measures to be adhered to shall be as detailed in IS 4081, Safety Code of Blasting (as amended from time to time, and to related drilling operations). Also digest No.37 of C.R.R.I and I.R.C.A. Road tariff No.18 shall be adhered to.

Blasting operation shall be carried out under the

supervision of a responsible authorised agent of the contractor. Timings shall be as approved by the Incharge in writing. Lunch break will be preferred. The authorised agent of the contractor should be well conversant with the rules and regulations of blasting operations. Further the contractor shall employ licensed blasters for actual operation.

- 6.2.3 All proper precautions for safety shall be taken. All persons shall be moved away to a distance not less than 200 m. All entries shall be sealed and red flags
- 6.2.4 displayed at prominent places.
- Blasting shall be done only with gunpowder. Dynamite, gelignite, or any other high explosive shall be used only
- 6.2.5 with written permission of the Incharge.
- The number of charges to be fired and the actual number of shots heard shall be counted and the contractor's agent shall satisfy himself by examining that all charges have exploded. Only then shall
- 6.2.6 workmen be allowed to start work. Unexploded charges shall be flooded with water, a new hole drilled and exploded again.
- 7.0** The Incharge shall be informed about all misfires, their
- 7.1 causes and the remedial steps taken.

CLASSIFICATION

All soils comprising any of the following :

- (a) Vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose murrum.
- (b) Any mixture of soils in (a).
- (c) Mud concrete below ground level.
- (d) Generally any material which yields to the ordinary application of a pickax and shovel or to phawra, rake or other ordinary digging implement and not affording resistance to digging greater than mentioned in (a) to (c).
- 7.2(e) Stiff heavy clay, hard shale, or compacted murrum requiring close application of a grafting tool or pick or both and shovel.
- (f) Gravel and cobblestone (cobblestone is a rock fragment), usually rounded, having maximum dia in one direction of 75-300 mm.

Soft rock comprising any of the following

- (a) Soling of roads, paths, etc. and hard core.
- (b) Macadam surfaces of any description (water bound, grouted, tarmac, etc.)

- (c) Lime concrete, stone masonry, in lime mortar and brick work in lime or cement mortar, below ground level.
- (d) Soft conglomerate, where the stones may be detached from the matrix with picks, crowbars, wedges, etc.
- (e) Limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with a crowbar.
- (f) Unreinforced cement concrete which may be broken up with crowbars or pickaxes and stone masonry in cement mortar, below ground level.
- (g) Boulders not requiring blasting, rock fragments usually rounded by weathering, disintegration and exfoliation or abrasion by water or ice, having maximum dia length in any direction of 500 mm, found loose, embedded, etc.
- (h) Other varieties of rock which would normally be removed with pick, crowbars, wedges and hammer with only a little difficulty.

7.3 Hard rock comprising any of the following

- (a) Any rock or cement concrete in excavation for which the use of mechanical equipment or blasting is required.
- (b) Reinforced cement concrete.
- (c) Boulders bigger than 1/2 cubic meter requiring blasting.
- (d) Hard rock as in (a) to (c) requiring blasting but prohibited from doing so for any reason and excavation has to be carried out by chiseling, wedging or any other agreed method.

8.0

8.1

FILLING

Filling shall be done where required with approved quality of earth. It may be from excavation and, where possible, cutting and filling shall be done simultaneously to avoid double handling.

8.2

Filling shall be done in layers not exceeding 15 cm in depth. Earth used shall be free from roots, grass and rubbish and all lumps and clods exceeding 8 cm in any direction shall be broken down. Each layer shall be watered with optimum moisture content to achieve 95% Procter density. Consolidation shall be done by mechanical roller of minimum 12 tonnes weight. The roller shall pass a minimum of 10 runs evenly to achieve dense consolidation. All undulation made up and final layer re-rolled.

8.3

Measurement shall be for compacted volume in Cubic Meter.

8.4

Sand filling

The sand shall be free from any organic and deleterious materials as detailed in IS. It should be suitable for compaction. Filling shall be in layers of 15 to 20 cm watered with optimum moisture content and mechanical rammers.

Measurement shall be for compacted volume in Cubic Meter.

Rubble soling

Good quality 150 mm to 230 mm thick rubble soling shall be carried out depending upon the grade of soil. Rubble used shall be at least 100 mm for 150 mm thick soling and 150 mm for 230 mm thick soling. Stone shall be hand packed as close as possible and bedded firmly with the broadest face downwards and the greatest length across, voids filled with chips and small stones. These shall be hammered down to achieve packing and the complete filling of interstices. To achieve the desired levels and slopes, pegs at suitable intervals (about 12m) shall be fixed.

9.0

Soling shall be watered and again packed with sand or murrum to fill interstices created by watering. Then it shall be rolled with 10 (on roller or vibratory compactor. Filling sand or murrum, watering and rolling shall continue till full compactness is achieved to satisfaction of the Incharge.

10.0

10.1

Measurement shall be in Square Meter.

PLANKING AND STRUTTING

In case of deep trenches where the soil is soft and not capable of being retained without the help of support, planking and strutting as required shall be carried out. It shall be the responsibility of the contractor to take steps to prevent slide/collapse. Method of planking/strutting will be largely influenced by the type of soil encountered and as approved by the Incharge.

DISPOSAL OF SURPLUS EARTH

Surplus earth shall be used to the maximum extent in the compound. Earth useful for filling shall be separately stacked as directed by the Incharge from time to time.

Approved quality earth shall be used in the filling. It shall be consolidated as detailed and approved by the Incharge.

10.2

10.3

Rate for excavation shall include sorting out of useful materials.

11.0

All surplus and unusable earth shall be disposed off outside the plot but at a location approved by local authority and conforming to their specification. The contractor shall quote his rate for disposing off or carting away the items considering requirements and standards of the local authority with whose permission surplus and unusable earth shall have to be disposed off.

DEWATERING

Bailing or pumping out of water that may have accumulated due to rains, subsoil seepage, or any other means shall be carried on continuously and the area shall be kept dry for the following operations:

- (a) Measurements
- (b) Concreting or masonry work
- 12.0 (c) Shuttering and reinforcement
- 12.0 (d) Backfilling
- (e) Line out
- (f) Any other reason deemed fit by the In charge.

MEASUREMENT

The following shall not be measured separately and allowance for the same shall be deemed to have been made in description of the main item.

- (a) Setting out works, erecting profiles, etc,
- (b) Site clearance such as clearing of shrubs, brushwood, small trees not exceeding 30 cm in girth measured at one meter above ground.
- (c) Unauthorised battering or benching of excavations.
- (d) Forming (or leaving) DEAD MEN or TELL-TALES in borrow pits and their removal after measurements.
- (e) Forming or leaving steps in the sides of deep excavations and their removal after measurements.
- 12.2 (f) Excavations for insertion of planking and strutting.
- (g) Removing slips or falls in excavations.
- (h) Dewatering by bailing or pumping out of water in excavations from rains, sub-soil water, tides, undercurrents, etc.
- (i) Slinging or supporting pipes, electric cables, etc. met during excavation or while carrying out any other item of work.
- (j) Dressing, trimming of sides, leveling, or grading and ramming of

bottoms.

Sooi Soils, soft rocks, hard rocks shall be measured as per SP 27 Part I except for the followings :

- (a) Filling shall be in cubic meter for consolidated volume. The lift shall be considered from made-up ground level.
- (b) (b) Planking and strutting required to be left in position shall be measured separately. Incharge's permission in writing shall have to be obtained for this. In no other case shall payment be made for planking and strutting, if carried out.
- (c) (c) Lead and lifts shall be as per the BOQ.

SECTION-II A

CONCRETE WORK

GENERAL

1.1 Standard

Work shall be carried out to Indian Standards and Code of Practices, in absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies /conflict noticed shall be directed to the Incharge for his direction / approval. However as a general rule more stringent specification shall take precedence.

Specification for Ordinary and low heat, portland cement Specification for 43 grade ordinary portland cement Specification for 53 grade ordinary portland cement

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|-----|-------------|--|
| (1) | IS 269 | Specification for Ordinary and low heat, Portland cement |
| (2) | IS 8112 | Specification for 43 grade ordinary Portland cement |
| (3) | IS 12269 | Specification for 53 grade ordinary Portland cement |
| (4) | IS 383 | Specification for Coarse and fine aggregates from natural sources for concrete |
| (5) | IS 456 | Code of practice for plain and reinforced concrete |
| (6) | IS 460 | Specification for test sieves (Part I, II & III) |
| | i) | Wire cloth test sieve |
| | ii) | Perforated plate test sieve |
| | ii) | Method of examination of test sieves |
| (7) | IS 515 | Specification for natural and manufactured aggregates from natural sources for concrete. |
| (8) | IS 516 | Method of test for strength of concrete |
| (9) | IS 875 | Design loads for building structure. |
| | (Part I, II | |

- & III)
- (10) IS 1199 Method of Sampling and analysis of concrete
 - (11) IS 1791 Batch type concrete mixers.
 - (12) IS 1893 Earthquake resistant design.
 - (13) IS 2386 Method of test for aggregate for concrete (Part I, II & III)
 - i) Particle size and shape
 - ii) Estimation of deleterious materials and organic impurities
 - iii) Specific gravity, density, voids, absorption and bulking.
 - (14) IS 2505 General requirements for concrete vibrators.
 - (15) IS 2645 Specification for Integral cement water proofing compound.
 - (16) IS 3025 Method of Sampling and test (Physical and Chemical for water)
 - (17) IS 4326 Code of practice for earthquake resistant design and construction of building.
 - (18) IS 4926 Specification for ready mixed concrete.
 - (19) IS 7861 Code of practice for extreme weather concreting
 - i) Recommended practice for cold weather concreting
 - ii) Recommended practice for cold weather concreting
 - (20) IS 9103 Specification for admixture for concrete
 - (21) IS 12118 (Part I)
 - Specification for two parts polysulphide based sealant: general requirements
 - (22) SP 23 Handbook on concrete mix
 - (23) SP 24 Explanatory handbook on Indian Standards code for plain and reinforced concrete (IS 456)
 - (24) SP 27 Handbook of method of measurement of building works.

1.2 Quality Assurance

- 1.2.1 Concrete used on site shall comply to relevant parts of Standards, Codes of practices, technical specification given in particular or approved, designed mixes as prepared, approved and adopted for works to give designed strength, serviceability, long term durability etc.
- 1.2.2 Provide and monitor quality control over materials received from suppliers / manufacturers to ensure that materials comply with standard specified and are as approved.
- 1.2.3 Provide experienced supervision and work force to ensure that workmanship is of specified quality.
- 1.2.4 Work shall not be subjected to harmful, dangerous, damaging or deleterious exposures while it is in progress or on completion during contract period.
- 1.2.5

Contractor to under take quality assurance by documenting.

- Test report for material used in producing concrete.
 - Mix design details with laboratory test report, actual site trial mix test and accepted modified design if any
 - Pour cards with approval of the Incharge prior to placement
- 1.3
- 1.3.1
- Control charts
 - Non conformance reports, changes, orders etc.

Submittals

Submit samples of all materials such as cement, sand, aggregate, admixtures, water etc to be incorporated into concrete along with test certificates from recognized laboratories for the Incharge's approval.

1.3.2 Samples

During construction, the materials shall be sampled and tested as often as directed by the Incharge to the contractor. Samples shall be taken and tested in accordance with latest revisions of Indian standard specifications and the cost thereof shall be borne by the Contractor.

1.3.3

Shop Drawings

- 1.4.0 Contractor shall prepare and submit method, mode of casting of slabs, beams with details of construction and expansion joint for approval of the Incharge.

Examination of conditions

Contractor shall inspect and examine sub strata and confirm prior to start that.

- Substrate is acceptable and approved by Incharge
 - Conditions are satisfactory
 - Setting out/Layout is verified
 - Corrective measures needed if any are within reach and contractor proceeds with full responsibility for work.
- 2.0
- 2.1

MATERIALS

Cement

Cement shall be ordinary Portland Cement conforming to IS and shall be of grade 53/43 for structural use or as specified in drawing.

- It shall be received in bags of 50 kg or loose in tankers and each batch shall be accompanied with a test certificate of the factory. Also it shall be tested before use to ascertain its strength, setting time, etc. In case cement has been stored for over 3 months or for any reasons the stored cement shows signs of deterioration or contamination, it shall be tested as per the direction of the Incharge prior to use in the works.
- 2.2
- 2.2.1

Coarse aggregate

2.2.2 Coarse aggregate shall be obtained from natural sources such as stone, gravel, etc., crushed or uncrushed or a combination thereof from approved quarries. Aggregate shall be hard, strong, dense, durable, clean and free from veins and adherent coatings. It shall be free from soft, feeble, thin, elongated or laminated pieces and shall be roughly cubical in shape. It shall consist of coarse material, most of which is retained on 4.75 mm IS sieve.

2.2.3 Coarse aggregate shall not contain any harmful material such as iron, pyrites, coal, mica, shale or similar laminated material; neither shall it contain clay, alkali, soft fragments, sea shells, organic impurities, etc. in such quantities that adversely affects the strength and durability of the concrete. In addition to the above, in reinforced concrete the aggregate shall not contain any material which might attack the reinforcement. The maximum quantities of deleterious materials in the coarse aggregate, when determined in accordance with IS 2386 Part I and Part II "Method of test for aggregates for concrete" shall not exceed the limits laid down in table 1 of IS 383.

Aggregate crushing value, impact value, abrasion value and soundness of aggregate shall respectively be in accordance with para 3.3, 3.4, 3.5 and 3.6 of IS 383.

2.2.4 Grading of coarse aggregate shall be in conformity with the requirements laid down in IS 383. See table 2 and table 3.

The grading of coarse aggregate shall be such that not more than 5% shall be larger than the maximum size and not more than 10% shall be smaller than the smallest size. Between these sizes the coarse aggregates shall be well graded.

For heavily reinforced concrete the aggregate shall be subjected to tests in accordance with IS 2386 or and directed by the Incharge.

2.2.5 The maximum size of coarse aggregate should not be greater than one fourth of the minimum thickness of the member and it should be restricted to 5 mm less than the minimum clear distance between the main bars or 5 mm less than the minimum cover to the reinforcement.

Source of aggregate shall be from an approved Government location. It shall be tested prior to the approval of the Incharge from an approved testing laboratory. In case available aggregates do not meet certain requirements of IS 383 or any other specification, required processing shall be carried out by the contractor at his cost. No extra cost towards these processes, treatment or combination of both shall be paid. It shall be the duty of the contractor to make

2.2.6

2.2.7 sure that aggregate material received by him is from Government approved quarries and with fully paid royalties, taxes, duties, etc. as may be in force from time to time for respective locations.

Coarse aggregate shall have a minimum specific gravity of 2.6. (Saturated surface dry basis). Aggregate below this specific gravity shall not be used without the special permission of the Incharge.

Once a specific source of supply of coarse aggregate is approved, the source shall not be changed without the prior approval of the Incharge.

Fine aggregate

2.2.8 Natural sand deposited by stream or glacial agencies as a result of disintegration of rock shall be used as fine aggregate. Fine aggregate shall pass through 4.75mm sieve in total. Crushed sand may be added to natural sand in approved proportions to achieve required grading. The fine aggregate (coarse sand FM above 2.25 & Fine sand F M more than 1.25) shall conform to following standards.

(i) For plain and reinforced concrete IS 383
Specification for coarse
and fine aggregates from natural
sources for concrete.

(ii) Mortar and grout IS 2116 Specification
for sand for masonry
mortars.

Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay. Sand shall not contain harmful impurities such as iron, pyrites, coal particles, lignite, mica shale or similar laminated material, alkali, and organic impurities in such form or quantities as to affect the strength or durability of concrete or mortar. Also it should not contain any material liable to attack the steel reinforcement.

When tested as per IS 2386 Part I and Part II, fine aggregate shall not exceed permissible quantities of deleterious materials as given in table 1 of IS 383.

Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious material is within the permissible limits laid down.

2.2.9 Grading of fine aggregate shall conform to IS and shall fall within limits of one of the four zones given in table 4 of IS

2.3.0 383.

Due allowance for bulking due to damp and moist sand shall be made while preparing the mixes based on volume measurements. It shall be determined as per IS 2386 Part III

2.4

2.4.1 Appendix A.

Water

Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalies, acids, salts so as not to weaken mortar, or concrete or cause efflorescence or attack the steel in RCC while curing. It shall be free of elements, which significantly affects the hydration reaction or otherwise interferes with hardening of concrete during curing or those elements which produce objectionable stains or deposits. Potable water is generally satisfactory but it shall be tested prior to use in the works.

Water tested shall be in accordance with IS 3025. Maximum permissible limits of deleterious materials in water as given in IS 456.

Suitability of water shall be ascertained by the compressive strength and initial setting time test as specified under:

a) Average 28 days compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90%

2.4.4 of the average strength of three similar concrete cubes

2.4.5 prepared with distilled water. Preparation and testing to be in accordance with IS 516. b) The

2.5 initial setting time of test blocks made with proposed

2.5.1 cement and water to be used shall not be less than 30 minutes and shall not differ by $\pm$ 30 minutes from the initial setting time of control test block prepared with the same cement and distilled water.

2.5.2 Preparation and testing of block shall be in accordance with IS 4031.

The PH value of water shall not be less than 6 and more than 9.

Water shall be tested and approved in writing by the

2.5.3 Incharge prior to use in the works,

Admixture

These are substances other than cement, aggregate and water and shall be permitted to be used to modify the properties of concrete for single, or a combination of purposes. This shall be used only on the written approval for specific purpose and at the cost of the contractor. Good concrete shall be achieved without the aid of any admixtures.

Admixtures shall be free from chlorides and sulphates which might affect concrete or any other material which may cause problems to the concrete in the due course of time. Also it shall have no effect on the reinforcement in case of Reinforced Cement Concrete.

Admixtures generally in use are classified as under:

- a) Accelerators
- b) Retarders
- c) Workability agents
- d) Water repelling agents
- e) Air-entraining agents
- f) Gas-forming agents
- g) Corrosion inhibitor additive

These are manufactured and sold by various companies under brand names. The contractor proposing to use any one of them shall submit to the Incharge technical literature with its chemical composition, purpose of use and method recommended by the manufacturer and what he proposes to follow at site for strict control.

2.5.4

The contractor's proposal shall accompany the followings with his request to use admixture.

- a) The trade name of the admixture, its source and the manufacturer's recommended method of use.
- b) Typical dosage rates and the possible detrimental effects of under and over-dosage.
- c) Whether the admixture contains chloride in any free form or any other chemical present as an active ingredient which is a likely cause of corrosion of reinforcement or deterioration of concrete.

2.6

2.6.1

- d) The average expected air content of freshly mixed concrete containing an admixture which causes air to be entrained when used at the manufacturer's recommended rate of dosage.

2.6.2

Miscellaneous

Integral cement water proofing compound specified for specific use shall conform to IS 2645.

2.6.3

2.6.4

Bituminous felts for waterproofing and damp proofing course shall conform to IS 1322.

Bituminous compounds for water proofing purposes shall conform to IS 1580. Expansion joint filler

2.6.5

Bituminous impregnated premoulded preformed expansion joint filler board conforming to IS 1838 part (I) specification for preformed filler boards shall be of approved quality and thickness at designated locations.

Polysulphide sealants

- 1 Expansion, construction or other joints shall be sealed with approved quality polysulphide sealants.
- 2 One part gun grade polysulphide-based joint sealants shall conform to IS 11433 (Part I). It shall be used

with the approval of the Incharge and as per the manufacturer's instructions. Correct primer shall be used at the specified location.

3 Two part polysulphide based sealant gun grade or pouring grade shall conform to IS 12118 (part I). Pouring grade shall be used in horizontal joints. Gun grade shall be used in vertical, inclined and horizontal joints. Specified primer shall be applied prior to the use of sealant. Use of sealant shall be as per instructions of the approved manufacturer.

4 Sealant shall be cured at ambient temperature and humidity when applied as per the approved manufacturer's instruction and received in suitable packs. Each package shall indicate

Manufacturer's name and trade mark

Weight of the components

Instructions for storage

Type and grade of sealants

Date of manufacture and expiry

2.6.6 Instructions for use

Water bar

PVC or rubber water bar of type, quality and width shall be used as approved by the Incharge. Water bar shall be continuous and fixed at the indicated locations. Water bar should be welded or Joined with the approved method. All angles and corners shall be purpose-made and shall be joined with the approved method.

2.7

2.7.1

Delivery and Storage

It shall be received in bags of 50 kgs and each batch shall be accompanied with a test certificate of the factory. Reject damp or torn bags.

Cement shall be stored in dry and water proof shed so as to prevent deterioration due to moisture, dampness. Bags shall be stacked on rigid water-proof platforms about 15 to 20 cm clear above the floors and 25 to 35 cm clear or away from the surrounding walls. A maximum high stack of 10 bags permitted. Stacks shall be so arranged that the first batches are used first, (FIFO) and that they permit easy access for inspection and handling.

2.7.2

Loose cement received shall be stored in silo's. Silo's shall be equipped to receive cement by pump and manually. Silo's shall be water tight and damp proof to keep cement fresh.

2.7.3

Coarse Aggregates and Fine Aggregates

2.7.4

Aggregate shall be stored in such a way that it does not get mixed with mud, grass, vegetables and other foreign

- 3.0** matter. The best way is to have a hard surface platform made out of concrete, bricks or planks. It should be to the approval of the Incharge.

Water

Water storage tanks shall be such as to prevent any deleterious materials getting mixed with it.

Covered storages

- 3.1** Considering the atmospheric/ weather conditions at site storages, covering shall be arranged to take care of temperature controls at site.

CONCRETE

- 3.1.1** Concrete is prepared by mixing graded aggregate of stone or along with cement, in a specified proportion. Mixing shall be done by a mechanical mixer. Manual hand mixing shall be permitted in specific cases with the written permission of the Incharge on account of small quantity or location or any other reason acceptable to the Incharge.

- 3.1.2** Cement concrete

This shall be classified as plain cement concrete or reinforced cement concrete. Plain cement concrete shall be In leveling course under foundations, floors, copings. etc. and shall include form work as part of the work.

Reinforced cement concrete shall be at all locations and comprises form work. reinforcement and concrete. Payment of reinforced cement concrete may be composite or item wise as specified in the BOQ. In PCC, payment for form work shall not be made.

Concrete shall be classified by its compressive strength at the 28th day. The concrete grades shall be as designated in table 2 of IS 456 "Grade of concrete".

Design.mix

BOQ shall specify various types of concrete aimed to be used in works. It shall be the responsibility of the contractor to carry out design mixes and approval of the same shall be obtained from the Incharge atleast 35 days in advance from the actual pouring of concrete at site in the permanent works.

1. Mix design of concrete shall be done as per IS 10262 & SP 23,24. Following basic points shall be finalised.

- Characteristic compressive strength and targeted compressive strength required at design stage.
- Standard deviation factor based on site actual execution conditions.
- Minimum cement specified in BOQ or as per IS for strength and durability for location where concrete is to be used.

- Water cement ratio permitted by IS.
- Workability to be achieved for better workmanship and good quality concrete
- Admixtures to be used if any
- Aggregates being used are tested to IS383. Include for Alkali reactivity, chloride and sulphate contents independently and combination of cement and water.
- Water being used is tested.

Further the contractor shall ensure that designed mix meet minimum cement contents as specified in BOQ/drawings and proposed revision to IS 456 along with maximum water cement ratio, to different exposure condition from durability point of view. In addition contractor shall ensure

a) Alkali - reactivity

Aggregates containing material susceptible to attack by alkali's (Na_2O and K_2O) originating from cement or other sources and producing expansive reaction shall not be used.

The aggregates source shall be initially tested for alkali reactivity prior to being used in design mix.

b) Sulphate and chlorides in concrete

Harmful salts coming from the concrete materials such as cement, aggregate, water and admixture, as well as by diffusion from environments shall be limited to following weight of cement.

- Total chlorides (as Cl) -0.15%
- Total soluble sulphate (as 803) - 4 %

3.1.3.1 Compressive strength

For expected strength of cubes tested on the 28th day, the design mix at preliminary test and work site shall be as per IS 456 - 2000.

Water cement ratio

The water-cement ratio shall be between 0.42 to 0.55. Additional water may be permitted only at the discretion of the Structural Engineer. The slump shall depend upon the

- 3.1.4 location and type of work. Higher slump with use of plasticizers shall be permitted.
- 3.1.4.1

Trial mixes

The contractor shall submit, at least 5 weeks in advance, to the Incharge the mix design that he proposes to use at site. The mix design in addition to points in 3.1.2 shall also give basic details (when tested according to IS 1199 and IS 2386-Part III 1963), as per followings

- a) Slump/Workability
- b) Bleeding
- c) Compacting factor

- d) Vee-Bee time
- e) Cement required for one cubic meter of concrete
- 3.1.4.2 f) Wet and dry density
- g) Air contents if applicable

On receipt of this, the Incharge may immediately order to carry out work site test before the final approval. This shall be done with mixer and materials actually being used at site. This shall give the contractor additional chance to check for himself actual workability and make sure that the mix proposed by him will be fully satisfactory with regards to slump, segregation, bleeding, water-cement ratio and workability.

- 3.1.4.3 6 cubes shall be taken from each of the 3 batches to test the mix. Cubes shall be cast, stored, cured, transported and tested to IS 516. The test may be carried out at site or laboratory as approved by the Incharge.

Trial mixes shall be approved provided that average strength of 3 consecutive cubes is not less than that specified and that one out of three may give a value less than specified but limited to a maximum of 90% of the specified strength.

In case the trial mix falls below the above criterion, the Incharge shall order fresh trial mixes to be made as before, until the desired strength is arrived at.

- 3.1.4.4 This design mix and trial mix hold good so long as the materials continue to be of the same quality and from the same sources. For any change, the Incharge may order fresh design mix and trial mixes to be carried out before the same

3.1.5 Is used at site.

- 3.1.5.1 Mixing of concrete

Machinery and equipments.

- a) Batching

Batching shall be done by weigh batchers conforming to IS 2722. A platform scale of capacity 300kg with fraction upto 100gms shall be at site.

For water supply to mixture through metering system shall be organised.

Design mix converted to volumetric may be permitted by Incharge. Accordingly suitable size of boxes equivalent to 1 bag of 50kg cement shall be prepared by the contractor.

- b) Mixer

Mixers used shall conform to IS. Type Capacity shall be as per size, extent and nature of work.

- c) Transportation

Wheel borrows, cranes, mini dumpers, truck, agitators, belt conveyors, pumps with piping etc. as per requirement depending upon location, size extent and nature of work shall be deployed by the contractor with prior approval of the Incharge.

d) Vibrators

3.1.5.2

Internal and external vibrators working on electricity, Pneumatic or petrol shall be approved by the Incharge. Vibrators shall conform to IS.

e) All machineries and equipments shall be maintained regularly. Periodic calibration of all machines shall be done and records maintained in a register. As and when requested by the Incharge same shall be forwarded for his inspection.

3.1.5.3

At the start of mixing, mixer shall be rinsed/coated by loading with cement, sand, water of the same proportion of batch to be used. Loading the mixer/charging the mixer shall be done mechanically and care to be taken that all material is fully loaded.

The mixer shall be run for a minimum period of 2 minutes after all materials are loaded in full quantity. The concrete produced shall be uniform in colour and consistency. Unless agreed by Incharge the first batch of concrete from mixer shall contain two-third of normal quantity of coarse aggregate.

Transportation

Concrete shall be transported to place of pour as far as possible in most efficiently, conveniently and without loss of concrete characteristic. Method of transportation shall depend upon the location, size and nature of work. Concrete should be placed within 1.5 hours of production i.e. prior to initial set.

Use of admixtures such as air entraining agent, retarders etc. shall be adopted and incorporated into design mix stage.

Concrete shall be kept in agitating state when ambient temperatures are high. This shall increase placing time to 1 % hrs after water is added.

Points to be taken care are

Method adopted do not permit segregation

Containers used are leak proof

Containers are well covered during rains, heavy winds

3.1.5.4

Concrete does not get contaminated by oil, dirt etc.

Placing

The placing temperature of concrete shall not be more than 34° C. If it is more, the Incharge may order addition of ice or chilled water to the concrete. Also the contractor shall take the following precautions :

- a) Mixers and weigh batchers shall be painted with white colour
- b) Aggregate storing bins shall not be exposed to the Sun
- c) Water shall be sprinkled on aggregates well before concreting to keep the temperature low.

3.1.5.5 d) Use chilled water for mixing or add flake ice as a proportion of the mixing water.

- e) Place concrete at night.
- f) Ready mix concrete (RMC)
- a) Concrete

Ready mix concrete as approved only shall be used. It shall comply all requirements of concrete. Batching plant, mixture, truck mixture, pump etc shall conform to relevant Indian standard. Daily returns shall be provided showing total volume of each class of concrete received.

- b) Pumping of concrete
Stationery or mobile pumps as per requirements shall be deployed. Concrete shall be continuous to avoid any blockage within pump. Concrete mix shall be with slump as desired by pump manufacturer and most desirable at site to pump operator / supervisor.

Required piping, bends, clamps, chutes etc. shall be well organised and placed in position prior to start so continuous concrete with minor changes

3.1.6 will keep concrete flowing at predetermined location in approved manner.

Mix design adopted shall be approved by Incharge and shall

conform all test as detailed in specification.

3.1.7 Pump concrete shall flow quite fast and is placed with larger impact on formwork. Hence special precautions at design stage of formwork shall be

taken and staging /scaffolds should be well restrained in all directions to withstand thrust.

Pumping shall be done with due care and safety. Recommendation of pump suppliers shall be followed strictly.

Shrinkage cracks

Concreting shall be avoided in very warm weather. If necessary, it shall be covered with dampened hessian within 2 hours of placing of concrete.

To achieve good results the concrete shall be immediately covered with a plastic sheet and not allowed any direct wind contact. This shall eliminate shrinkage cracks.

Laying of concrete

a) Concreting shall commence only after form work is approved, reinforcement is recorded and permission to proceed with concreting has been approved in writing from the Incharge.

b) Form work should be clean, free from sawdust, pieces of wood or any other foreign material. It should have been treated by form releasing agent prior to the laying of reinforcement and concrete. Prior to placing concrete against old concrete, masonry, rock all loose materials shall be removed and surfaces washed down. Concrete shall be worked around ties and bond and in open joints.

c) Concrete shall be as gently deposited as is practically possible, in its final position to avoid re-handling and shall be so deposited that segregation of aggregates does not occur. In case of deep trenches and footings, it may be done with the help of a chute. Columns and walls shall be so adjusted in form work so that maximum depth is 1.5 metre unless consented to by the Incharge. Concrete from wheel barrows shall not be dumped away from the face of concrete already in place. It shall be dumped into the face of concrete already in place. In excavations prevent contamination of earth and concrete without disturbing unsupported sides of excavation. Concrete shall not be placed in water except where specified.

3.1.8

d) Concrete onto a sloping surface shall be discharged by providing a chute with a baffle and a drop at its end so that the concrete remains on the slope.

e) Columns and walls shall be concreted in one operation to their full height to avoid any horizontal construction joint as far as possible.

f) All slabs, beams, wooden planks, and cat-walks shall be provided clear of reinforcement.

3.1.9

g) Concrete shall be placed in position within 30 minutes from the time it is produced. Concrete shall be laid during normal working hours. Concreting at night or on holidays shall be permitted only on the written approval of the In charge.

h) Placing in each section shall be a continuous between

construction joints. The contractor shall make provision for standby equipment. In case of delay or break down stop ends are to be provided or concrete placed to be removed as per direction of the Incharge.

i) Placing shall not take in open during storms or rains, strong winds. Contractor to organise and provide required protection.

Compaction of concrete

Concrete shall be thoroughly compacted as depositing shall proceed by means of able vibrators. The vibrators shall maintain the entire concrete under treatment in an adequate state of agitation and shall continue during the whole period occupied by placing of concrete. Care shall be taken not to over- vibrate the concrete. While withdrawing needles no holes should be visible in concreting. Compaction shall be completed before the initial setting time. Concrete already set shall not be disturbed by successive vibrations.

3.1.10 It shall be ensured that the needle vibrators are not applied on reinforcement which may destroy the bond between concrete and reinforcement.

3.1.11 When electric vibrators are in use, the standby petrol vibrator must always be available at the concreting point.

Construction joints

In large pours, it is practically not possible to carry on concreting continuously. Hence construction joints shall be provided. Location of construction joint shall be submitted by the contractor for approval of the Incharge. Such joints shall be kept to a minimum. The joints shall be at places where shear force is nil or minimum and these shall be straight and at right angles to the direction of the main reinforcement.

Stop ends provided shall be with necessary slots for reinforcement bars to pass freely without bending or any other obstruction. Also a trapezoidal fillet nailed on stop board shall be provided to form a regular keyed joint. Joints shall be straight and truly vertical or horizontal.

Before commencement of concrete, adjacent concrete stopper and surfaces shall be chipped and roughened to expose aggregate, then wire brushed and cleaned. The concrete surface shall be sprayed with water for 24 hours before casting and kept wet until casting.

True horizontal joints shall also be provided with a keyed joint by inserting planed greased timber.

Prepared joint shall be treated as above prior to the start of fresh concreting.

For vertical joints neat cement slurry shall be applied on the surface just before concreting. For horizontal joints, the

surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in the concrete mix. This layer of cement slurry shall be freshly mixed and applied just before concreting.

Expansion joints

Expansion joints shall be formed and located as detailed in the drawing. Insert sealant to completely fill the joint and finish neat and smooth.

Curing

Curing of concrete is most important. There shall be no compromise on this activity and it is for the contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the Incharge. As said above in clause 3.1.8, after concrete has begun to harden i.e. about 1 to 2 hours after laying,. it shall be protected from quick drying with moist or damped hessian cloth or any other material approved by the Incharge. After 24 hours of laying of the concrete, the surface shall be cured by flooding with water or covering with damp hessian cloth for a period of 7 days to keep it moist.

For the next 7 days the surface shall be kept wet all the time by sprinkling water continuously.

For membrane curing, details as listed in 12.5 of SP

3.1.12 24 shall be followed.

Finishing

Concrete shall be finished keeping in mind the next operation to be carried out over the surface. For guidance the following points shall be noted but the Incharge shall be consulted prior to start of concreting and his decision in this regard shall be final.

a) Roof slab shall be trowelled even and smooth with a wooden float.

b) The surface that will receive plaster shall be roughened immediately.

c) Surfaces that will be in contact with any masonry work shall be roughened immediately,

d) The surface that will receive mosaic floor or IPS or any other type of tiled work shall be roughened while it is green. Every care shall be taken not to disturb the freshly laid concrete.

3.1.13
3.1.13.1

e) For dust proof (or hardened) finish, clean the concrete surface of oil and contamination and apply approved dust proof hardener as per manufacturers instructions.

Inspection and corrective measures

On removal of form work, the surface shall be examined by the Incharge. Till such time, no remedial measures shall be carried out by the contractor. All patching, rectification or chipping shall be done only on the Incharge's instructions. In case of any violation of this rule, the concrete poured stands rejected. The decision of the Incharge in this regard shall be final and binding on all parties.

3.1.13.2

Sagged, bulged, patched, honeycombed work shall stand to be rejected for surfaces that are exposed, or require fair face finish or decorative textured finish. The Incharge may permit any work found structurally safe and areas of unexposed faces, for repairing. As directed by the Incharge these works shall be retained and the cost of repair shall be at the contractor's account.

Cracks observed shall be brought to the notice of the Incharge who shall examine them. It shall be kept under observation and a record shall be maintained for a period of 45 days. It shall be shown to (lie Structural Engineer and the following procedure shall be followed :-

a) Cracks not developing further and in the opinion of Structural Engineer not detrimental to the strength of the construction shall be grouted with non-shrinking cement slurry or as directed by the Incharge.

b) Cracks developing further and, in the opinion of the Structural Engineer, detrimental to the strength of construction, shall be tested as per the relevant Indian standard.

c) Based on results of the test, the Incharge in consultation with the Structural Engineer shall order remedial measures or order the contractor to dismantle construction, cart away the debris, replace the construction and carry out all the consequential works thereto.

d) Cost of the above shall be borne by the contractor if the failure was on his part. In case it is due to design faults, it shall be borne by the employer.

e) The decision of the Incharge in this matter shall be final and binding on all parties. This decision shall not be open for arbitration.

3.1.14

3.1.14.1

Testing

Quantum of cubes and testing

The minimum frequency of cube casting shall be as follows. Each sample shall consist of 6 cubes.

Concrete quantity	Number of Samples.
-------------------	--------------------

Upto 5 cu m in a day	: 1
----------------------	-----

5 cu m to 15 cu m	:	2
15 cu m to 30 cu m	:	3
30 cu m to 50 cu m	:	4
More than 50 cu m	:	4 + one additional per each 50 cum or part thereof

- 3.1.14.2 Three cubes shall be tested on the 7th day and other three cubes on the 28th day.

Field Tests

It is the responsibility of the contractor to prepare and get the cubes tested and to provide all the material, labour, moulds, equipment, casting and curing facility, charges for testing, etc.

Further, the contractor shall have to provide and maintain all the equipment and staff at the site throughout to carry out the following tests in a small laboratory or get these tests from approved laboratories without extra cost to the

- 3.1.14.3 contract.

- a) Grading of coarse and fine aggregates
- b) Silt content of sand
- c) Moisture content of coarse and fine aggregates
- d) Slump test of concrete
- e) Concrete cube test

- 3.2 The contractor shall maintain full records of all above tests

- 3.2.1 in a register. The format of records shall be prepared in consultation with the Incharge and either he or his representative shall have full access to the contractor's

- 3.2.2 laboratory.

The contractor shall include charges for the above work in his rates and no extra whatsoever shall be admissible on this account of designing, testing, maintaining laboratory, etc.

Concreting under special conditions

Work in extreme weather conditions

During hot or cold weather the concreting should be done as per the procedure set out in IS 7861 Part I or IS 7861 Part II or as directed by the Incharge

Underwater concreting

The procedure set out under 13.2 of IS 456 shall be followed or as directed by the Incharge

- 3.2.3 Concreting in sea water

The procedure set out under 13.3 of IS 456 shall be followed or as directed by the Incharge.

- 3.2.4 Concreting in aggressive soils and water

Guidelines laid down in 13.4 of IS 456 shall be followed together with the Instructions of the Incharge.

- 3.3.0 Precast concrete

- 3.3.1 Precast concrete can be plain or reinforced. It shall meet all

requirements and specifications of concrete as stated hereof. Precast concrete shall be done for cellular roof units, drainage or specially designed for specific use taking Into consideration achievements In flexibility, speed and economy in construction.

3.3.2 Precast concrete units shall be cast in a suitable mould so as to make sure that they are,

- a) Easy to lift
- b) Easy to transport
- c) Excellently finished
- d) Handy to erect and Join at site

3.3.3 Units shall be sound and free from cracks or any other defects that would interfere with the proper placing of units or the strength or performance of units or the structure.

Precast units shall be lifted and handled with proper tools from points designated to avoid any cracking or developing of any undue stresses . If required, necessary tools and tackles shall be fabricated by the contractor. Precast units shall be removed from mould within 24 hours or the time allowed by the designer or as approved by the Incharge.

All units that are. in the opinion of the Incharge, cracked and unsafe, shall be removed forthwith and no arbitration on this account shall be applicable.

3.4.0 Units shall be stored and stacked in the precasting yard in a proper manner. The date of casting shall be noted therein and wet curing for 15 days shall be done without fail. The yard shall have a duly dressed ground and sufficient supports at the required intervals to receive precast units.

Units shall be erected only after 28 days of casting and after the cubes of those days have given the strength specified.

Tolerances in units shall not be more than ± 3 mm as approved by the Incharge taking into consideration the purpose and location of use.

Plum Concrete

Stone plums shall be used only when specified. Size of stone plums may be from 150 to 300mm.

Plums shall be hard, double clean and free from soft or loose pieces or deleterious material and should not have sharp corners.

3.5.0 Generally first layer of concrete of specified mix shall be of thickness 2.5 time thickness of maximum size of plums to be used. Plums shall be laid when concrete becomes stiff but top portion is still green. No plums shall be used for concrete laid under water. The thickness of next and successive layers shall be 2 times that of largest plums.

Measurements

1. All works shall be measured in the decimal system.

- a) Dimensions shall be measured to the nearest 0.01 metre except for thickness of slab which shall be measured to the nearest 0.005 metre.
- b) Areas shall be worked out to the nearest 0.01 sq m
- c) Cubic contents shall be worked out to the nearest 0.01 cum
2. All measurements of cutting shall, unless otherwise stated, be held to include the consequent waste.
3. Cement concrete work shall be classified as under:
 - a) Concrete cast in-situ : Plain and reinforced
 - b) Precast concrete : Plain and reinforced
 - c) Prestressed concrete : Cast in-situ or pre-cast
4. All concrete, except as hereinafter provided, shall be measured in cubic metres.
5. The price of concrete shall include ingredient material, mixing, transporting, hoisting to any height and lowering to any depth, pouring or laying, consolidating, leaving pockets, holes, and protecting them till the next operation or completion of work, hacking the surface to provide key for further work including cleaning, wetting surface, etc. and preparing construction joints as described in clause 3.1.9. of this section.
6. Concrete processed in a special manner for any specific purpose, such as cooled, heated, water-proofed, acid-proofed, heat-resistant shall be measured separately and as per provision in BOQ.
7. Admixtures shall be used if necessary at the request of the contractor for workability and the price for that shall be deemed to be included in the contractor's quoted price of concrete.
8. No deductions shall be made for:
 - (a) Ends of dissimilar materials (for example beams, posts, girders, purlins, corbels and steps) upto 500 sq cm in section.
 - (b) Opening upto 0.1 sq m,
 - (c) Volume occupied by reinforcement.
 - (d) Volume occupied by drainage, water pipes, conduits, etc. not exceeding 100 sq cm, each in cross sectional area.
 - (e) Small voids each not exceeding 40 sq cm in section.
 - (f) Small moulds, drip moulds, chamfers, splays, rounded

or covered angles, beads, grooves and rebates upto 10 cm in depth and width.

9. Expansion joints shall be measured in running metre or sq m as the case may be. Price shall include required shuttering, special treatment if any,

filler and finishing material as detailed in drawing or the BOQ.

10. Water proofing of concrete shall be measured separately as an extra over ordinary concrete stating the quantity of water proofing material in litres or kilograms.

11. Surface treatment shall be measured in square metres stating number of coats and proportioning of water proofing liquid to water.

12. Grouting of holding-down bolts and providing temporary boxing or wedges to form holes shall be enumerated. The mix shall be specified.

The price shall include required shuttering, grouting, etc.

13. To keep surface dry while concreting, dewatering due to rains and seepage shall be included in the price of concrete.

SECTION - II B

REINFORCEMENT WORK

1.0 GENERAL

1.1 Standard

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/ conflict noticed shall be directed to the Incharge for his direction/approval. However as a general rule more stringent specification shall take precedence.

1. IS 226 Specification for steel standard quality.
2. IS 228 Methods for chemical analysis of steels.
3. IS 280 Specification for mild steel wire for general engineering purpose.
4. IS 432 Specification for mild steel and medium tensile steel bar and hard drawn steel wires for concrete reinforcement.
Part 1 Mild steel and Medium tensile steel bars.
Part 2 Hard drawn steel wire.
5. IS 456 Code of practice for construction and design of reinforced concrete.
6. IS 816 Code of practice for use of metal arc welding for general construction in mild steel.
7. IS 961 Specification for structural steel: high tensile steel bars
8. IS 1566 Hard drawn steel wire fabric for concrete reinforcement.
9. IS 1599 Method of Bend test
10. IS 1642 General requirements for fire protection.
11. IS 1785 Cold drawn stress relieved wire (part I)
12. IS 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.
13. IS 2751 Code of practice for welding of MS bars.
14. IS 2502 Code of practice for bending and fixing of bars for concrete reinforcement.
15. IS 2751 Code of practice for welding of MS Bars.
16. IS 3696 Safety Code of scaffolds and ladders:
Part I Scaffolds
Part 2 Ladders
17. IS 4014 Code of practice for steel (Part 1 & 2) tubular scaffolding
18. IS 4082 Recommendation on stacking and storage of construction materials at site.
19. IS 5525 Recommendation for detailing of

- reinforcement in RCC work.
20. IS 9417 Recommendation for welding cold worked steel bars for reinforced concrete construction.
21. IS 10790 Method of sampling of steel for prestresses and reinforced concrete.
- 1.2 Quality Assurance
- 1.2.1 The Contractor shall procure and provide reinforcing steel bars conforming to IS specified and shall comply with all physical, chemical and mechanical test. Each
- 1.2.2 type shall be from same manufacturer. Steel manufacturers shall conform steel produced conforms IS requirements for reinforced cement concrete works.
- 1.2.3 Steel shall not react chemically with ingredient of
- 1.2.4 reinforced cement concrete which are harmful to strength, durability of reinforced cement concrete.
- 1.2.5 Unit weights and diameter of rolled steel bars shall conform to IS.
- Provide supervision and work force with minimum 5 (five) years experience to ensure workmanship of specified quality.
- Contractor to undertake documenting of
- Test reports for steel brought at site for each lot
- 1.2.6 a) Chemical composition from factory
- 1.3 b) Mechanical
- 1.3.1 c) Physical
- Barbending schedule for cutting and bending
- 1.3.2 • Record of laps and anchors / development length
- Work shall not be subjected to harmful, dangerous and damaging exposures.
- Submittals
- Submit for approval of the Incharge all details of Material / Product which conforms the specification laid down in documents.
- 1.3.3 Submittals shall include
- Product data sheet
 - Manufacturers certificates
 - Test report of laboratories
 - Alternative product if any with tabulation for conformation that alternatives proposed meets / exceeds specification.
- Samples
- Samples of type materials to be used. Further during construction samples shall be taken and tested by the Contractor as per specification and as directed / instructed by the Incharge. The cost of samples and test

shall be borne by the Contractor within quoted prices.

1.3.4 Shop drawings

Contractor shall prepare and submit bar bending schedule based on structural detailed drawing prior to fabrication for approval of the Incharge.

1.4 Examination of Conditions

Contractor shall inspect and examine sub strata and confirm prior to start that.

- Substrate is acceptable and approved by Incharge
- Conditions are satisfactory
- Setting out/Layout is verified
- Corrective measures needed if any are within reach and contractor proceeds with full responsibility for work.

2.0

2.1.0 **MATERIAL**

2.1.1 Reinforcing Bars

Reinforcement bars used in construction shall be mild steel or medium tensile steel round bars and high strength deformed bars. Steel shall be fresh and new. It shall be free of defects and free of rust, oil, paints, grease, loose mill scale or any other deleterious material undesirable for RCC or prevent adhesion of concrete with reinforcement.

M S Plain

Rolled mild steel and medium tensile steel plain round bars used in concrete shall conform to IS 432 Part I. Steel received shall conform to the following IS with regard to manufacturing and chemical composition.

2.1.3

1. M.S. bar Grade I Steel designation Fe 410-S of IS 226
2. M.S. bar Grade II Steel designation Fe 410-0 of IS 1977

2.1.4

3. Medium Tensile Steel designation Fe 540 Steel bars W-HT IS 961

Nominal sizes and tolerances shall be as specified in IS 432 Part I. Physical requirements shall be determined in accordance with IS 1608, read in conjunction with IS 226. For reference of minimum requirements, properties are tabulated in IS 432 Table 1 "Mechanical properties of bars mild steel & tensile steel bars".

2.1.7

Tor / TMT (Thermo-Mechanically-Treated) Steel

High-strength deformed bars for use as reinforcement in concrete shall be of grade Fe 415, Fe 500 and Fe 550 conforming to IS 1786.

Chemical composition shall conform to IS 1786 when

made as a relevant part of IS 228.

Welding of cold work steel bars in reinforcement shall be permitted as per IS 2751 and 9417. (Recommendation for welding cold worked steel bars for RCC).

Nominal sizes, cross sectional areas and their mass shall be as specified in IS 1786, allowing due consideration for tolerances specified therein.

2.1.8 Physical properties

- a) It shall satisfy IS 1599 test for bend and rebend test in conjunction with IS 226.
- b) Bond requirements shall be deemed to have been satisfied if it meets clause 4.0 of IS 1786.
- c) Tensile, proof stress and percent elongation shall be as per table 3 of IS 1786.

2.1.9 Material received at site shall have ISI certification mark. Each bundle or coil containing the bars shall be suitably marked with ISI certification mark. Also bars shall be marked to identify categories. This shall be done as per IS 1387.

In case bars are without ISI certification mark, the manufacturer shall give a certificate stating process of manufacture, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark of the batch production/ cast to which it applies. Corresponding number or identification mark should be found on the material.

2.1.10 All reinforcement material shall be free from loose mill scale, excessive rust, loose rust, pitting, oil, grease, paint, mud or any foreign deleterious material present on the surface. Cleaning shall be done to the satisfaction of the Incharge.

Each batch brought at site shall be tested prior to use for respective specification / physical properties. Cost of all such tests shall be borne by the contractor. Material acceptable as per IS shall be allowed into the works. All rejected material shall be removed from site by the contractor within 3 days of rejection. If the same is not done, the Incharge shall impose a penalty of Rs.500/- per metric ton per day. This will be without any appeal and shall not be subjected to arbitration.

2.2.0 Cover block

Cover blocks shall be of non-corrosive material such as plastic but not wooden or broken bricks or stone. Designed purpose made PVC cover spacers shall be used in the Works. Concrete cover spacers may be permitted

- 2.4.0 by the Incharge. Such concrete spacers shall be cast from concrete and not cement-mortar. Strength of these blocks shall be equal to the strength of concrete in use. These should be fully cured prior to use in works.

Binding Wire

Binding wire shall be 16 or 18 gauge annealed wire conforming to IS 280. It shall be free from rust, oil, paint, grease, loose mill scale or any other deleterious material undesirable for the reinforcement and concrete or which may prevent adhesion of concrete with reinforcement.

Mechanical Splices

Mechanical Splices fabricated out of steel pipes, sheets etc. capable of withstanding bending and compression stress equal to 1.25 times of those specified for reinforcing bars shall be used. Supplier of splices should submit details about quality of materials, mechanical test results and method of splicing. Required hydraulic press and clipping equipments shall be arranged by the Contractor.

Sa Samples pieces shall be prepared at site and shall be tested for torsion.

Sample pieces results should give value of about 1.5 times than required for reinforcing bars.

2.5.0 Delivery and Storage

Reinforcing steel bars each batch should accompany manufacturers certificate. Reinforcement bars received at site shall be loaded and unloaded at site and stored with care such that it does not get bent or damaged. Steel received shall be as far as possible in straight length of 12 M. Steel shall be weighed in presence of representative of the contractor prior to delivery being received by him. Empty and loaded truck loads shall indicate correct quantity.

Reinforcement bars received at site shall be stored on hard concrete platform and clear of the ground with the use of timber sleeper, concrete sleeper or any other means. Reinforcement material shall be kept covered by

3.0

3.1 tarpaulins or plastic to avoid excessive corrosion and other contamination. Each dia of bars shall be stacked separately. Bars without 'ISI' / Tor marking shall not be brought to site.

SCOPE OF WORK

The contractor shall be responsible for

Material Procurement

a) The contractor will submit the Schedule of Procurement of steel in consultation with Incharge

as specified and

conforming to specifications detailed in drawings and bills of quantities.

The steel is free supply by the client to be delivered to site as per approved indent of the contractor to agreed schedule. However further all balance work to complete the reinforcement bar item shall be same as materials are supplied by the Client.

- b) Receive steel and stack with covering on firm platform free of contamination.
- c) Collect samples of each type for every batch received and test as per IS for
 - Unit weight per running meter
 - Cross section area
 - Bend / Rebend Test
 - Ultimate tensile strength
 - Yield stress
 - Elongation
- d) Procure binding wire, cover blocks splices etc. Prepare bar bending / cutting schedule detailing schedule covering as under and obtain approval of Incharge.
 - Cutting lengths
 - Laps
 - Rings for various locations and items
 - ChairsTransport, cut, bend and shift to site reinforcing bars. Place in position and tie as detailed in drawing reinforcement with specified cover Provide attendance to keep reinforcement in position during concreting.
- Disposal of surplus reinforcement steel as per approval of the Incharge.
- Providing required tools, plants, equipments such as
 - Material cutting and bending tools
 - Bending platform Bar cutting machine
 - Bar bending machine
 - Hydraulic clipping machines
- Unit weights payable per metre shall be as follows-
 - 1. 6mm : 0.22 kg/Rmt
 - 2. 8 mm : 0.40 kg/Rmt
 - 3. 10 mm: 0.62 kg/Rmt
 - 4. 12 mm: 0.89 kg/Rmt
 - 5. 16 mm: 1.58 kg/Rmt
 - 6. 18 mm : 2.00 kg/Rmt
 - 7. 20 mm : 2.47 kg/Rmt

8. 22 mm : 2.98 kg/Rmt
9. 25 mm : 3.85 kg/Rmt
10. 28 mm : 4.83 kg/Rmt
11. 32 mm : 6.31 kg/Rmt
12. 36 mm : 7.99 kg/Rmt
13. 40 mm : 9.85 kg/Rmt

4.0 WORKMANSHIP

4.1 Fabrication of reinforcement

Reinforcement shall be fabricated as per the drawing and approved bar bending schedule. Bending shall be done mechanically or with hand but to the correct radius, with proper tools and platform and shall conform to IS 2502. Bending of material shall be cold bending only. Material shall be inspected for visible defects such as cracks, brittle, excessive rust, loose mill scale, etc. Cracked ends of bars shall not be used in Works. Also the bars should be free from any deleterious material and hence the best practice shall be to hose down reinforcement just prior to concreting.

4.2 It is important that bending, straightening, cutting, etc. shall be carried out in a manner not injurious to the material and the safety of the persons working should be ensured.

Anchoring

Anchoring of bars and stirrup shall be provided exactly as detailed in the structural drawing or as directed by the Incharge.

4.3 Lapping of bar

Laps shall be strictly as per the drawing or as directed by the Incharge. For general guidance, the following principles shall be followed as given in IS 456.

- a) Splices shall be provided as far as possible away from sections of maximum stress and be staggered.
- b) Not more than half of the total bars shall be spliced at a section.
- c) Where more than one half of the bars are spliced at a section or where splices are made at points of maximum stress, special precautions shall be taken, such as increasing the length of lap and/or using spirals or closely spaced stirrups around the length of the splice.
- d) Lap splices shall not be used for bars larger than 36 mm diameter: For larger diameters, bars may be welded. In cases where welding is not practical, lapping of bars larger than 36 mm diameter may be permitted and additional spirals should be provided around the lapped bars.

- 4.4 e) Lap length including anchorage value of hooks in flexural tension shall be L_d (as defined in 25.2.1 of IS 456) or 50 dia whichever is greater.
- f) When splicing of welded wire fabric is to be carried out, lap splices of wires shall be made so that the overlap measured between the extreme cross wires shall be not less than the spacing of cross wires plus 10 cm.

Spacing of bars

Bars shall be placed in position as shown in the drawing. Following guidelines as given in IS 456 shall be followed in case of difficulties or shall be carried out as directed by the Incharge.

- a) Horizontal distance between two parallel main reinforcing bars shall usually not be less than the greatest of the following:
1. The diameter of the bar, if the diameters are equal.
 2. The diameter of larger bar, if the diameters are unequal, and
 3. 5 mm more than the nominal maximum size of coarse aggregate (By using reduced size of aggregate in congested reinforced area, conditions given hereof should be overcome).
- b) Greater horizontal distance should be provided. But when needle vibrators are used, distance between bars of a group may be reduced to two-thirds of the nominal maximum size of the coarse aggregate, provided sufficient space is left between groups of bars to enable the vibrator to be immersed.
- c) Where there are two or more rows of bars, the bars shall be vertically in line and the minimum vertical distance between the bars shall be 15 mm, two-thirds the nominal maximum size of the aggregate or the maximum size of bar, whichever is more.

4.5 Cover to reinforcement

Reinforcement shall have concrete cover and the thickness of such cover (exclusive of plaster or other decorative finish) shall be as specified in drawing or as directed by the Incharge. The following guidelines are to be observed in the absence of the above.

- a) At each end of the reinforcing bar, not less than 25 mm, nor less than twice the diameter of such bar;
- b) For a longitudinal bar in a column, not less than 40

mm, nor less than the diameter of such bar. In the case of columns of minimum dimension of 200mm or under, whose reinforcing bars do not exceed 12 mm, a cover of 25 mm.

- c) For longitudinal reinforcing bar in beam, not less than 25 mm, nor less than the diameter of such bar.
 - d) For tensile, compressive, shear or other reinforcement in slab, not less than 15 mm, nor less than the diameter of such bar; and
 - e) For any other reinforcement, not less than 15 mm, nor less than the diameter of such bar.
 - f) Increased thickness shall be provided in case the concrete members are in the surrounding of harmful chemicals, saline atmosphere, etc. and the cover shall be 50 mm or more as directed by the Incharge.
 - g) For concrete members totally immersed in sea water, the cover shall be 40 mm more than specified above (a) to (f).
- 4.6 This shall be 50 mm more for periodical immersion in seawater.
- h) Concrete cover should not exceed 75 mm in any case. Cover to reinforcement shall be as specified in the drawing or as directed by the Incharge.
- Details given in sub para (a) to (h) are for guidance and shall be followed in absence of any specific direction.

Welded joints or mechanical connections

A) Welded joints or mechanical connections in reinforcement may be used but in all cases of important connections, tests shall be made to prove that the joints are of the full strength of the connected bars.

Welding of reinforcement shall be done in accordance with IS recommendation. Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that, at any one section, not more than 33 percent of the rods are welded.

B) Welding rods used shall conform to IS 814 : covered electrodes for metal arc welding of structural steel. Work shall be carried out by a competent welder. Samples from work site shall be taken at regular intervals and tested. Frequency and number of samples shall be as directed by the Incharge.

4.7 Fixing in position

- 4.7.1 Correctly cut and bent bars shall be accurately placed in position as detailed in the drawing. Unless otherwise

specified by the Incharge, reinforcement shall be positioned within the tolerance as under:

- a) for effective depth 200 mm or less, +10 mm
- 4.7.2 b) for effective depth more than 200 mm, +15 mm

But in no case shall the cover be reduced by more than 5 mm of that specified. There shall be no compromise on cover for foundation work.

4.7.3 Reinforcing bars shall be held in position during the placing of concrete by use of PVC or concrete cover blocks (made of equal strength of well-cured concrete in use), steel chair spacers, steel hangers, supporting wires, etc. and secured by tying with an annealed binding wire of 16 to 18 gauge as approved by the Incharge.

4.7.4 Layer of bars shall be separated by precast concrete spacer blocks or spacer bars. Reinforcement shall be in correct position prior to start of concreting. No reinforcing bar shall be placed on freshly laid concrete for adjusting bar spacing. Care shall be taken to maintain reinforcement in position and keep it clean, throughout the period till it is embedded in the concrete.

4.7.5 For maintaining cover, pieces of broken stone or brick or wooden blocks shall not be used at any stage.

5.0

Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time is the radius of the bend less than 4 bar diameters in case of plain mild steel or 6 bar diameters for deformed bars. Care shall be taken when bending back bars to ensure that the concrete around is not damaged/disturbed.

MEASUREMENTS

Reinforcement shall be measured as follows:

1. Lengths of different diameters of bars actually used including authorised overlaps shall be measured nearest to a centimeter and their weight calculated.

a) If steel is procured by the contractor, weight per metre given in table 3.9 shall be used.

b) If material is supplied by the client free of cost on tonnage basis to the project site, per metre weight for each diameter of the bar shall be fixed by the incharge from actual

stocks of steel available at site or weight per meter given in

table 3.9 shall be used.

2. Chairs and spacer bars shall not be measured and paid. For reconciliation purpose it will be taken into account.
3. In case of welded coupled joints, measurement for payment shall be equivalent to the length of overlap, as per design.
4. Price build-up shall include, in addition to cost of material,
 - a) Cover blocks of PVC or concrete.
 - b) Cutting, bending, placing and fixing in position.
 - c) Binding wire as approved.
 - d) Cleaning of bars.
 - e) Unloading, weighing cost (to conform the weight of steel) and storing the same in proper forms and conditions on platforms.
5. In case the material is supplied by the owner free-of-cost, it shall include the following in addition to 4a) to 4d) above.

Transportation from owner's store to work site and returning surplus material back to store.
6. For purpose of reconciliation, maximum wastage permitted shall be 3% of the actual material used (returnable to owner). Balance shall be charged at 1.5 times the actual market rates as penalty.

SECTION - II C

FORM WORK

1.0 GENERAL

1.1 Standards

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/conflict noticed shall be directed to the Incharge for his direction/approval. However as a general rule more stringent specification shall take precedence.

- | | | |
|---|---------|--|
| 1 | IS 303 | Specification for plywood for general purpose. |
| . | | |
| 2 | IS 456 | Code of practice for construction and design of reinforced concrete. |
| . | | |
| 3 | IS 2751 | Code of practice for welding of M.S bars used for RCC |
| . | | |
| 4 | IS 3696 | Safety Code of scaffolds and ladders : |
| . | | |
| | Part 1 | Scaffolds |
| | Part 2 | Ladders |
| 5 | IS 4014 | Code of practice for steel (part 1 & 2) tubular scaffolding |
| . | | |
| 6 | IS 4082 | Recommendation on stacking and storage of construction materials |
| . | | |
| 7 | IS 8989 | Safety code of erection of concrete formed structures |
| . | | |

1.2 Quality assurance

Contractor shall assume and take upon himself to

- a) Design, construct, erect, maintain and struck form work proprietary or custom made
- b) Form work shall provide required
 - Shape, size and finish
 - Rigidity and durability during placing(live levels)
 - Rigidity and durability for receiving fresh concrete
 - Leak proof water tight joints/junctions
 - Easy removal without disturbing concrete
 - Provide easy access for handling and placing
- c) Form work shall provide safety and shall have adequate access for concreting

- d) Workers shall work with required safety measures such as safety belts,

1.3 Experience

The contractor shall provide

- a) Site supervisors and foremen qualified and experienced atleast 5(five) years on similar nature of form work.
- b) Semi skilled/skilled labour shall be of minimum experience of 5(five) years in doing similar nature of form work

1.4 Examination of strata

The contractor shall examine, and convince himself prior to start of work that strata is firm, rigid and safe to erect scaffold. In absence, same shall be prepared by him and then work shall proceed. If it is not possible due site condition, method of erection support etc. shall be detailed and got approved from Incharge prior to start. In any case responsibility of formwork shall be that of the contractor.

2.0 MATERIAL

2.1 Timber

- a) Jungle wood timber in form of planks, battens (runners), ballies, strong durable without cracks, able to sustain warping, twisting and distortion shall be allowed in work for type of requirements.
- b) Teak wood /good quality jungle wood shall be used for special decorative moulds. Moulds may be smooth planed or finished with laminate

2.2 Steel

Standard rolled steel sections shall be used with due fabrication of standard special moulds, unitised form work scaffolds, staging etc.

2.3 System

Patented proprietary designed metal (Steel, aluminium or fiber glass) form work best suited for type of work under taken and its requirements shall be used.

2.4 Wire nails confirming to IS and mating needs shall be used.

2.5 Bolts / Nuts /Clamps

MS bolts, nuts, clamps standard or purpose made shall be used. Use of these shall not be harmful to concrete and shall be easily removable or If left In concrete shall be inert to concrete in all respect.

2.6 Form release Agents

Emulsion and oil or chemical agent being used shall not react with reinforce concrete at any stage. No chemical reaction shall take place which may be harmful to reinforcement concrete for its durability strength. These shall not produce any stain and shall not stick to concrete surfaces which will reduce further bonding strength of masonry mortar, painting etc.

3.0 SCOPE OF WORK

3.1 Designing

The contractor shall draw, prepare and submit method of statement backed by designed calculations, taking into account the points noted in clause 1.2 here above at least six weeks prior to the starting of activity. Required drawing and sketches shall be enclosed along with statement for the proposed area to be taken up for working. The statement shall give

- Loadings considered
- Materials proposed
- Repetitions expected
- Staging/supporting arrangement
- Deployment of proprietary metal form work system.
- Method of handling

It shall be responsibility of the contractor to get the design approved from Incharge atleast four weeks prior to start of form work.

3.2 Equipments

The contractor shall provide required tools, plants, equipments including its proper maintenance during construction at site.

3.3 Proprietary metal formwork

The contractor shall arrange to provide proprietary system metal formwork applicable/adoptable to various areas of works. He shall be responsible to deploy with required mechanism for handling, shifting, transporting placing in position.

3.4 Supervision

The contractor shall be responsible to provide experienced foremen (atleast Five years) in supporting/executing similar nature and magnitude of work. He shall be able to read drawings and should be capable of guiding and getting work executed to quality.

3.5 Labour

The contractor shall provide experienced skilled carpenters to carryout work with system of formwork deployed and necessary plants and equipment shall be made available at site.

4.0 WORKMANSHIP

4.1 Form work shall be classified namely as follows :

- a) Textured or decorative finish
- b) Fair-faced finish
- c) Rough finish

4.2 In BOQ, the contractor shall account for all material and labour etc. to achieve the above finishes to the satisfaction of the Incharge in his quoted price.

1. Erection of form work may be from pre-moulded, pre-fabricated, pre-assembled plates or forms reasonable enough to transport and erect at site to correct line and level as set out at site. Supports shall be firm and

maintained in position by nails, cross bracings, tie rods, locking bolts and nuts. It shall be rigid and stiff so as to retain its shape during and after concreting.

2. Joints shall be water-tight and no cement slurry shall be allowed to slip through. In joints foamed tapes shall be used.
3. Pre-fabricated or site forms shall be assembled, so as to deshutter without any jerk to the green concrete. For this double wedges shall be used. Wedges shall be nailed, the heads reasonably left out, allowing easy removal while deshuttering.
4. Pre-fabricated or on site fabricated forms shall be of sufficient thickness and with the required supporting runners in either direction. Supporting runners shall be standardised in size for easy replacement and universal use at site.
5. Props shall be of steel only. Teak ballies may be permitted with written permission of the Incharge for specific use. Size and verticality shall be approved by the Incharge. Its spacing shall be as per design. It shall be vertical and plumbed. Base shall be a proper steel plate or timber plank, for equal distribution of load.
6. In repeated use, panels shall be clearly marked for using at defined locations.
7. Successive lift shall be tightened with previous lift by fixing foamed strips at joints to avoid grout leakage.
8. In fill pieces and panels shall be well dressed, leveled and jointed with main formwork so as to achieve smooth, even natural finish.
9. Props, Soldiers, wallings, Shores, bearers, Clamps, wall & ties etc. shall be at required spacings.
- 10 Props, shores shall be securedly braced with firm bearing.
- 11 Provide and fix or fix only inserts pockets, to correct line and level and with sufficient rigidity to keep in position while concrete placing is in progress along with vibration.
- 12 Sloping, brackets, chajjas etc shall be well secured and firmly restrained.
- 13 Adequate access and working platform shall be arranged with required safety to avoid reinforcement displacement, damage to shuttering and easy movement of concrete gang.
- 14 Props and scaffolds are to be erected to correct plumb, line, level and with required tie. Load carrying capacity of props shall be as per table of manufacturer.

- 15 Props and scaffolds shall not be loaded more than allowed by manufacturer of Props /scaffolds.
- 16 Heavy, medium and light duty props shall not be mixed up.
- 17 Beams and slabs shall have camber of 4 mm per metre or as directed by the Incharge.
- 18 All angles and corners shall be sharp and well defined. In places where concrete edges are permanently exposed and require no further treatment, they shall be chamfered in a triangle of 25x25mm.
- 19 Props of steel or timber (if approved in writing) shall be provided with adequate horizontal and cross - bracing. Steel props shall use steel pipes and steel couplers. If use of timber is permitted, planks of 100 x 25 mm shall be used and shall be secured by nailing them to timber props. No other material shall be permitted.
- 20 At the design and erection stage, the following additional points shall be considered and incorporated into the shutters.
 - (a) Openings for cleaning prior to start of concreting.
 - (b) Pouring points shall avoid high drops and provide easy access to vibrator needles.
- 21 Surfaces shall be treated with mould releasing oil or emulsion as approved by the Incharge prior to reinforcement laying.
- 22 The following point shall be observed very carefully:
 - (a) Joints of moulds shall be water tight. It is easy to check from bottom and make sure that no light is visible.
 - (b) Props shall be on solid base, plumbed, in one straight line, and braced horizontally and cross.
 - (c) Tie bars in beams, walls and columns shall be at the correct place and fully tight.
 - (d) Wedges shall be fully secured and nailed with head left out for easy removal.
 - (e) All saw dust, dirt, shaving and any other unwanted materials shall be cleaned and hosed out.
 - (f) Provision shall be made for watching form work while concreting and any other platform needed for movement of workers without any disturbance to reinforcement.
- 23 Opening/inserts

All required openings and pockets shall be provided as detailed in the drawing. The contractor shall provide for

the required material, labour for fixing and supporting during concreting, in his quoted price. It is imperative that all openings and pockets shall be deshuttered with care and all corners of openings shall be preserved. All openings/pockets shall be in a correct line and level. After concreting, the openings shall be secured by proper covering against any accident and guard rail and warning notice, if any will be incorporated.

- 24 In case of multistoried building, any upper floor shall be suitably supported on atleast one floor below the same or as approved by the Incharge. The concreting of upper floor shall be done only after lower floors have attained the strength.

4.3 Checking prior to concreting.

1. All props and struts are plumbed at right spacing properly tightened up and locked.
2. Formwork is correctly aligned and leveled.
3. Stop ends are properly secured and sealed.
4. All ties are properly tightened.
5. All inserts, pockets etc are at desired level and secured.
6. Joints are sealed and no possibility of leakage of grouts.
7. Reinforcement has proper covers and required spacers.
8. All forms are cleaned, free from rubbish, tie wires etc.
9. Proper access for concreting and compaction available.
- 10 Required guard rails, toe boards are provided.

4.4 Tolerances

- 4.4.1 Tolerance is a specified permissible variation from lines, grade or dimension given in drawings. No tolerances specified for horizontal or vertical building lines or footings shall be considered to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted.

4.4.2 Tolerances for RCC buildings

2

1. Variation from the plumb:
 - (a) In the lines and surfaces of columns, piers, walls and in arises 3 mm per 2.5 m but not more than 10 mm.
 - (b) For exposed corner columns and other conspicuous lines,

In any bay upto 5 m maximum	:	5 mm
In 10m or more	:	10mm

2. Variation from the level or from the grades indicated on the drawings,

- (a) In soffits of slab, ceilings, beam and in arises

In 2.5 m	5 mm
In any bay upto 5 m maximum	8 mm
In 10m or more	10 mm

- (b) For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines,

In any bay upto 5 m maximum	5 mm
In 10m or more	8mm

3. Variation of the linear building lines from established position in plan and related position of columns, wall and partitions.

In any bay upto 5 m maximum	5mm
In 10 m or more	10 mm

4. Variation in the sizes and location of sleeves, openings in walls and floors 5mm (except in the case of and for anchor bolts).

5. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls - 5 mm + 10 mm

6. Footings

- a) Variation in dimension in plan • 5 mm + 50 mm

- b) Misplacement or eccentricity
2% of footing width in the direction of misplacement but not more than 50 mm

- c) Reduction in thickness
5% of specified thickness subject to a maximum of 50mm

7. Variation in steps

	<u>Riser</u>	<u>Tread</u>
a) In a flight of stairs	3mm	5mm
b) Consecutive steps	1.5 mm	3 mm

4.4. Tolerances in other concrete structures.

3

1. a) Variation of the constructed linear outline from established position in plan

In 5 m	: 5 mm
In 10m or more	: 10mm

- b) Variations of dimensions to individual structure features from established positions

- In 20m or more : 25mm
- In buried construction : 50 mm
- c) Variation from plumb, from specified batter or from curved surfaces of all structure
 - upto 2.5 m : 3 mm
 - 2.5 m to 5 m : 8 mm
 - 5m to 10m or more : 12mm
 - In buried construction : Twice the above
- d) Variation in cross sectional dimensions of columns, beams, buttresses, piers and similar members
(-) 5mm (+) 10mm
- e) Variation in the thickness of slabs, walls, arch sections, and similar members.
(-) 5 mm (+) 10 mm
- 2. Footings for columns, piers, walls, buttresses and similar members.
 - a) Variation of dimensions in plan
(-) 10 mm (+) 50 mm
 - b) Misplacement or eccentricity
2% of footing width in the direction of misplacement but not more than 50 mm
 - c) Reduction in thickness
5% of specified thickness subject to a maximum of 50mm

4.5 Removal of Form work

1. Forms shall not be struck until the concrete has reached strength at least twice the stress to which the concrete may be subjected at the time of removal of form work.
Under normal circumstances and where 53/43 grade O.P.Cement is used, forms shall be removed after expiry of the following periods:
 - a) Walls, columns and vertical faces 24 to 48 hrs
 - b) Slabs (props left under) 3 days
 - c) Beam soffits (props left under) 7 days
 - d) Removal of props under slabs
 - (i) Spanning upto 4.5 m 7 days
 - (ii) Spanning over 4.5m 14 days
 - e) Removal of props under beams and arches
 - (i) Spanning upto 6 m 14 days
 - (ii) Spanning over 6m 21 days

For other cements, the stripping time shall be suitably modified in consultation with the Incharge.

2. Where the shape of elements is such that the form work

has re-entrant angles, the form work shall be removed as soon as possible after the concrete has set, to avoid shrinkage or cracking that might occur due to the restraint imposed.

3. For precast moulds, the stripping time shall be 24 hours. The mould may be lifted and stored in the yard within 24 hours to 48 hours as approved by the Incharge.

4.6 Maintenance

It shall be responsibility of the contractor to protect, maintain and handover to next contractor / Employer in finished condition. No additional cost due to this shall be paid by the Employer Providing and fixing inserts is part of this

- a) On completion of concreting inserts shall be cleaned and required treatment such as oiling, greasing, covering with plastic/plywood boxes, painting etc. shall be carried out by the contractor to approval of the Incharge. Inserts and pockets shall be protected from weathering/or damage in course of construction.
- b) Opening and pockets shall be deshuttered with due care not to damage edges, falling of debries within pockets etc. Further all opening and pockets shall be preserved, secured against accident by covering, putting up guard rails, warning notice etc. as approved by the Incharge. Guarding and protecting pockets shall be responsibility of the contractor at no extra cost to contract.

4.7 Cleaning/Stacking

All formwork deshuttered shall be cleaned with a stiff wire brush to remove dust, grout, concrete etc. and if required maintained/repared prior to being reused. Steel plates, props, frames, proprietary formwork system shall be oiled, greased to protect against rusting, weathering etc.

Plywood and timber form shall also be applied with preservative agent if to be kept for long time without use. It shall be protected against heat, rains etc.

4.8 Measurements

Form work shall be paid for separately as per item details given in BOQ.

Wherever it is not specifically stated in description of the item that form work shall be paid for separately, the rate of R.C.C. item shall be deemed to be included in the cost of the form work.

1. Form work shall be measured as the area (in square meters) of shuttering in contact with the concrete.
2. It shall be measured to the nearest centimeter and the areas worked out corrected to second decimal places.
3. No deductions shall be made for openings upto 0.4 sq m in the plan.
4. Form work to secondary beams shall be measured upto sides of the main beams but no deduction shall be made from the form work of the main beam.
5. No deduction shall be made from the form work of column at intersection of the beam.
6. The quoted rate shall be applicable for all working conditions and at all heights, depths or lifts specified in the BOQ. The rate shall include the cost of materials and labour for various operations involved, such as,
 - a) Splayed edges, notching, allowance for overlaps and plastering at angles, battens, centering, shuttering, strutting, propping, bolting, nailing, welding, casing, striking and removal.
 - b) Filling to form stop chamfered edges or splayed external angles not exceeding 75 mm to footing and 25 mm to beams, columns and like.
 - c) Temporary openings in the forms for pouring concrete and removing rubbish.
 - d) Dressing with oil/approved emulsion/soap solution to prevent adhesion of concrete with shuttering.
 - e) Racking or cutting
 - f) Fixing inserts and openings at the correct line and level and any required stage to support the same at the directed height and place.
 - g) Platforms, if any, required to keep check on form while the concreting is in progress.
 - h) Filling and making joints water-tight to the satisfaction of the EIC.
 - i) Cleaning the shuttering.
7. Any work damaged through premature or careless removal of form shall be removed and reconstructed at the contractor's cost.
8. Holes for electrical conduits, hooks for fans and for plumbing are included in the price of items.